

Forage Quality Characteristics of Inbred Corn Lines and Their Derived Hybrids

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Introduction

Corn is becoming more important as a forage crop in the United States. Up to 10% of the corn acreage is harvested as whole-plant silage. The decision regarding whether corn will be harvested for silage, however, is usually not made at the time of planting. This decision is often based on availability of forage from perennial forage crops such as alfalfa. This, in turn, depends on how well perennial forages survived the previous winter and how favorable growing conditions were during the current year. Corn stover (aboveground vegetation less ears) following grain harvest can also be an important feed resource for beef animals and sheep either as grazed forage or as conserved baled forage. Breeding programs emphasizing the development of corn hybrids specifically for forage have generally had low priority in the USA. Some companies have initiated breeding programs for improved corn forage in the USA and other companies evaluate forage quality of their hybrids and report this information to potential customers. Historically, those hybrids with high grain yields and high grain-to-stover ratios have been recommended as most suitable for forage. Nearly one-half of the aboveground dry matter of corn is stover. Thus, it should not be surprising that stover digestibility also greatly influences overall corn forage quality. Additionally, animals fed corn stover would benefit from plants developed for higher stover digestibility.

Information is needed on the relationship between forage quality characteristics of corn inbreds and their derived hybrids to increase the efficiency in developing corn hybrids for high forage quality. Decreasing fiber concentration or increasing fiber digestibility are the two most straightforward methods for increasing forage digestibility. This study was conducted to determine the relationship among forage quality

of agronomically elite inbreds and their derived hybrids.

Materials and Methods

Twelve elite inbreds from the ARS/Iowa State University corn breeding program were used to develop twelve single-cross hybrids. These inbreds were B57, R227, NC258, Mo17, N28, B94, NC272, B52, B64, NC262, B79, and LAN496. Each inbred was used twice as a hybrid parent. Then, a replicated field study was conducted during 1994 and 1995 at Iowa State University Agronomy and Agricultural Engineering Research Center near Ames to evaluate both the inbreds and hybrids. Forage quality traits were measured by standard methods on both stover and whole-plant forage. Additionally, samples were fermented for 24 and 96 h to estimate the rapidly degraded neutral detergent fiber (NDF) and potentially degradable NDF fractions, respectively. The residual NDF ratio at 24 to 96 h was used as an estimate for rate of fiber digestion.

Results and Discussion

Genotypic variation for in vitro dry matter disappearance (IVDMD), NDF, and lignin/NDF were greater in stover and whole plant forage of the inbreds than in the hybrids. Additionally, whole-plant forage had larger genotypic ranges than stover. Generally, single-crosses of high forage quality inbreds resulted in high forage quality hybrids for whole plants (Fig. 1) with a poorer relationship in the stover (Fig. 2). There was a poor relationship between the estimate of rate of fiber digestion in the inbreds and hybrids. Significant genotype x year interactions occurred for several traits. NDF concentration explained less than 40% of the variation in stover IVDMD of both inbreds and hybrids. However, NDF concentration explained 62% of the variation for inbred whole-plant and 78% for hybrid whole-plant IVDMD.

Discussion

Given greater variation in forage quality among inbreds than hybrids and the positive relationship between whole-plant inbred and hybrid digestibilities, evaluating differences in agronomically elite inbreds should be an important criterion for selecting inbreds to develop hybrids with improved forage quality. Because of year x genotype variation, hybrids will need to be evaluated in several environments. The consistently negative relationship between fiber concentration and digestibility suggests that reduction of NDF may be an effective means of initially improving digestibility of forage corn. The lack of relationship between inbred rate of fiber digestion and hybrid rate of fiber digestion suggests that rate of digestion should be determined on hybrids. Additional research is needed to determine the stability of these relationships with other elite inbreds and environments. Because of the uncertainty of whether a hybrid will be used for forage at the time of planting, most forage hybrids will need to have high grain yield as well as high forage quality.

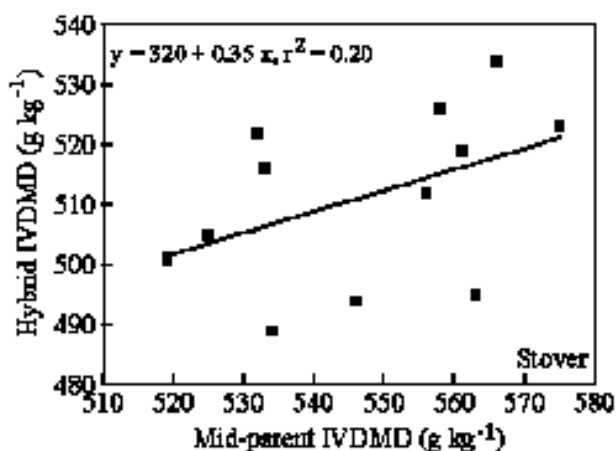


Figure 1. Relationship of stover digestibility of inbred parental average (mid parent) to that of the derived hybrid.

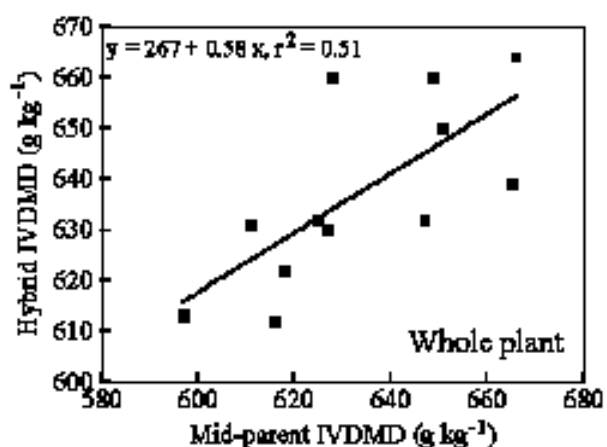


Figure 2. Relationship of whole plant digestibility of inbred parental average (mid parent) to that of the derived hybrid.